3.10 KUUGRUAQ

3.10.1 Location and Site Description – Kuugruaq

The Kuugruaq site is several hundred yards directly north of the Igrugaivik site and about 2 miles east of the existing Kivalina town site. From the air, the three sites on the south side of the Wulik River, including Kuugruaq, all appear to have the same characteristics: low, wet, ice-rich soils with numerous tundra ponds, sloughs and channels in and around the indicated areas.

No ground truthing site visit was conducted under this contract. The material presented here is a compilation of data gathered from existing literature dating back to 1994. From geotechnical reports, and from aerial photos, the site has both thaw stable soils with gravel and sand, plus ice rich permafrost soils. The Wulik River has undercut the permafrost areas leaving part of the village site thawed with gravel benches and willows. The undisturbed parts of the site have classical polygonal ground indicated ice rich permafrost.

When the Wulik River was at flood stage in 1993, approximately half the Kuugruaq site was inundated with floodwater (DOWL, 1994). Approximately 100 acres of site land was left above the 1993 flood level. Further investigations of flood levels should be conducted for this site before it is chosen.

Any consideration of this site as the new village site should take this information into account when laying out the new site.

3.10.2 Site Development – Kuugruaq

The fill depth over this site can vary depending upon the use of insulation placed below the fill to reduce the thickness of gravel. We anticipate that fill may be a minimum of 9 feet.

Grading should maximize the utilization of swales and roadside ditching as much as possible. Where lengths of grade and slopes combine to make swales and ditches too deep, drainage structures such as culverts, manholes, catch basins and subsurface piping shall be employed.

The full length of the north and west sides of the site may have to be protected with armor rock to protect against erosion from the Wulik River. Approximately 9,000 lf of erosion protection may be required.

3.10.2.1 Construction Considerations – Kuugruaq

Golder (1997) reports the active and abandoned floodplain portions of the site may be underlain by relatively thaw-stable soils. A thaw-stable subgrade would greatly simplify and reduce construction cost of structures and infrastructure. Commercial, municipal, and community structures could be founded on conventional foundations or pile foundations, and residential structures could be founded post-and-pad or on more conventional foundation systems. Road sections in town could be thinner. General site preparation for structures might involve replacing surficial frost-susceptible soils and raising the site grade above flood level with a nonfrost-susceptible fill. The area of potentially thaw-unstable soils for development is limited, and some facilities such as runway and access roads would have to be constructed over ice-rich, thaw unstable ground.

3.10.3 Infrastructure Development – Kuugruaq

3.10.3.1 Water – Kuugruaq

Based on the results of a geophysical survey conducted at the Kuugraaq site, Golder Associates (1997) found indications that a thaw bulb in abandoned floodplain deposits near the Wulik River bank might provide an adequate year-round source of readily treatable groundwater. A test well drilled in 2002 at the nearby Igrugaivik site produced

only saline groundwater (R&M 2002). The recommended Kuugraaq test well is located about ¼ mile further inland from the coastline than the Igrugaivik well. If the Kuugraaq well also proves to be saline, additional test wells targeting similar deposits and thaw bulbs further upstream along the river would be needed to identify a non-saline supply of groundwater, with corresponding added costs for a longer piping distance. The location of any additional wells should take into account the inland reach of tides and storm surge as a possible source of saline groundwater.

The Kuugruaq site is covered by a number of small tundra ponds, none of which appear large enough to provide a sustainable surface water source. If a surface water source from the Wulik River were used for Kuugruaq, a collection, treatment, and distribution arrangement similar to the existing Kivalina site would be required. Water would be withdrawn through a hose and pipe transmission line placed in the river and pumped to a raw water storage tank. If the Wulik River could be tapped with an infiltration gallery year round, the transmission line would have to be heated with a glycol loop to avoid freezing.

If a groundwater source is proved up for the Kuugruaq site, the proposed water supply system would likely consist of a well, pump house, water treatment building, relocation of an existing water storage tank from Kivalina, and an aboveground distribution system with forced circulation. S&W (2004) suggests that aboveground water and sewer utilities would be required for the eastern portion of the Kuugruaq site, due to the potential for differential settlement in old terrace deposits. Utilities could be directly buried in the western portion of the site, which is covered by floodplain deposits and relatively thaw-stable soils.

3.10.3.2 Wastewater – Kuugruaq

Because of the flat terrain and permafrost at Kuugruaq, a vacuum collection system and above ground arctic pipe system is recommended. DOWL (1994) stated the land area and construction materials are available to construct a sewage disposal system.

As stated above, S&W (2004) suggests that aboveground sewer utilities would be required for the eastern portion of the Kuugruaq site. For the western portion of the site, sewer utilities could likely be directly buried, and instability concerns with lagoon construction could be minimal. A leach field could be considered for wastewater disposal (S&W, 2004).

3.10.3.3 Solid Waste – Kuugruaq

There is a limited potential area of thaw-unstable soil available for development. Some facilities would have to be constructed over fine-grained, ice-rich, and highly thaw-unstable soil (S&W 2004). The area appears to represent an unstable thermal regime with very poor soils. Construction of a solid waste landfill would be difficult and expensive.

3.10.3.4 Fuel – Kuugruaq

Except for the location of marine headers and fill pipeline routings, the information in 3.2.6 Fuel applies to all potential sites equally.

3.10.3.5 Heating – Kuugruaq

The information in 3.2.7 Heating applies equally to all sites.

3.10.3.6 Electricity – Kuugruaq

The information in 3.2.8 Electricity applies equally to all sites.

3.10.4 Access – Kuugruaq

The Kuugruaq site can be made accessible using the same road design for Igrugaivik

shown in the USACE (1998) report. The 1998 report has a road design consisting of a 3 feet of fill, with 2 to 1 side slopes. The road width is 20 feet wide. The close proximity of the Kuugruaq site to the Igrugaivik site would necessitate only a short road extension to access the Kuugruaq site.

The proposed barge access road shown in Figure 15 would provide access to the Chukchi Sea for residents of a new community developed at Kuugruaq. The road should provide community access to both the sea and the lagoon.

The location of the site, inland from the lagoon, places it far enough away from the Chukchi Sea so that watching for whales from the site will not be possible.

The Wulik River makes up the west boundary of the Kuugruaq site. Access to the river can be direct from the site. If a gravel boat staging pad is not constructed at the barge landing at the Singauk Inlet, it could be built at the site to provide a more protected moorage for the community's boats.

Beach access from this site could be by foot or four-wheeler over the proposed gravel road to the Singauk Entrance, or by boat from the Wulik River, downstream to the entrance.

Constructed gravel roads from the new village site at Kuugruaq may be expensive to construct and maintain. A 1.47mile long Singauk Entrance access road cost is required. Additional road length may be required to reach the new runway and the Kuugruaq village site.

Road access to subsistence sites from the Kuugruaq site may be limited to the corridor between the Singauk Entrance barge landing and the new runway north of the Igrugaivik site, a maximum of approximately 3 miles. Access to areas to harvest greens, berries and hunt small game along the river or coastal beach is good. Traveling inland to the east or south from this site may be difficult over the soft soils and wet ground cover.

3.10.4.1 Goods & Supplies – Kuugruaq

A barge landing could be located on the beach southwest of the Kuugruaq site. Access to the barge landing to offload goods and supplies may be via a 1.75 mile long access road.

At the barge access site a 1 acre staging area should be constructed to enable loading and unloading of the barge. This staging area should allow the community to stage the materials and ferry them to the new village.

Goods and supplies can also be delivered via air. The location of the new airstrip is discussed in the following section.

3.10.4.2 Air Transportation – Kuugruaq

The location of the new airstrip would be at the same site as the Kiniktuuraq airstrip; approximately 7,500 feet northeast of the Kuugruaq village site. The relatively close proximity of the airstrip to the village would make it convenient for residents to access. Access to the airstrip would be over an approximately 1.75 mile long access road. A new airport should be constructed prior to occupancy of the new village site. Refer to Section 3.1 for general recommendations.

3.10.4.3 Roads & Streets within Community – Kuugruaq

The road layout within the community is expected to closely reflect the plan in Appendix G for the Phase I study report. Roads should be designed on a grid system to maximize flow of traffic and access to all portions of the new community.

The road system would be constructed on top of the gravel pad installed to protect the thermal regime of the underlying soils. An

estimated minimum of 9 feet of gravel may be required for a structural roadbed for community streets.

3.10.4.4 Roads Outside the Community – Kuugruaq

The location of the Kuugruaq site and the soil conditions of the terrain surrounding it make road construction difficult and expensive. It is anticipated that there should be as few roads as possible outside the village, accessing the new airstrip, solid waste facility and lagoon boat moorage area.

The USACE (1998) report describes a total of approximately 2 miles of road for the Igrugaivik site with the airstrip located at the Northeast end of the road, the barge landing at the West end of the road and the solid waste dump site situated between the new village and the barge site, a minimum of 10,000 ft from the runway. Because of new setback requirements for the airstrip, we recommend approximately 3 miles of road to reach all the facilities and still allow for proper distance between the landfill and the airstrip.

3.10.5 Native Allotments

There are two Native allotments in the immediate vicinity of the Kuugruaq site that constrain the layout of a new townsite (see Figure 13). These townsites are located along the northern half of the proposed townsite. Relocation at this site would likely require resolution of the use of these Native allotments and are a potential constraint to use of this site for relocation.

3.10.6 Relocation Costs – Kuugruaq

A construction cost estimate to relocate to this site has been prepared. Design and construction administration are not included in the costs. The cost estimate to build a new village site at Kuugruaq is $245.6 million. Detailed costs are included in Appendix A. A summary is included below:

Site work and Airport Construction	$164,800,000
Erosion Protection	$2,961,750
Construction Camp	$606,000
Power and Fuel	$5,292,000
Move Buildings	$1,125,000
New Buildings	$52,690,000
Water/Sewer System and Landfill	$18,146,638
Transportation System	N/A
Total Cost	**$245,600,000**

3.10.7 Recommended Plan for Kuugruaq

The Kuugruaq Site is the easternmost of the three village sites on the south side of the Singauk Entrance. It is located north and west of the Igrugaivik Site and abuts the Wulik River along its northern edge.

Access to this site should be from the beach barge landing near the Kiniktuuraq site.

The new runway for the village site at Kuugruaq may be located about 1.75 miles northeast of the site. It is anticipated that this area may provide a poor subgrade on which to base the 150 ft X 4,000 ft runway, and a geofabric base may be required to provide support and separation for the muskeg below.

Siting the landfill is more difficult for this site than most of the others because the best location, which is the same as for Kiniktuuraq and Igrugaivik puts it too far

away from the proposed village site to ensure it will be properly utilized year round. Locating the landfill on the west side of the new village gravel pad may provide the required 10,000 lf of separation from the new runway, as well as make access to it by the community convenient. This location will place the landfill farther away from the barge landing, but transportation of recyclable materials, batteries and hazmat to the barge landing for shipping can be accomplished by 4-wheeler and trailer or snow machine and sled.

The most likely raw water source for the Kuugruaq Site is the Wulik River. Potential sources of raw water will be investigated in the water study that is currently pending. There are no other known sources of water in the Kuugruaq area. It is anticipated that a raw water intake structure wick be constructed in a thaw bulb, to furnish a year round water supply.

The sewage lagoon may be located east of the town site on the east side of the road to the new airstrip. A surface discharge may be established to dispose of the treated lagoon effluent onto the surrounding wetlands.

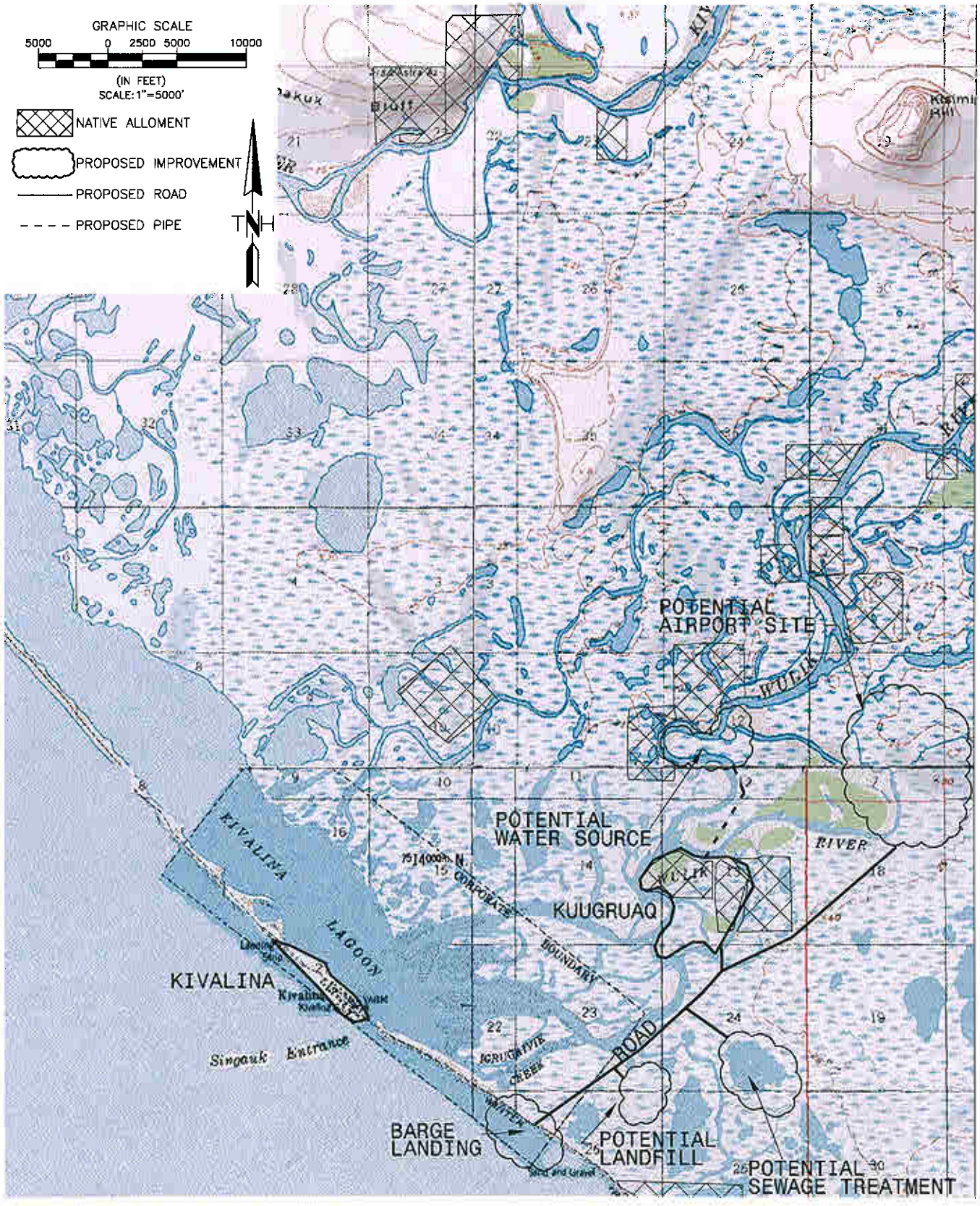

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FIGURE 15

KUUGRUAQ CONCEPTUAL LAYOUT

DESIGN BY: MEW	DATE: 6/16/06
DRAWN BY: JT	PROJECT No: 03003.007
SCALE: 1" = 5000'	REV. –
CAD DWG FILE:	
FIELD BOOK: –	SHEET 1 OF 1
GRID: –	